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Arapahoe County, Colorado

National Eutrophication Survey, Corvallis, Oregon

Prepared for

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Jun 77

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NATIONAL EUTROPHICATION SURVEY

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT

ON

CHERRY CREEK LAKE

ARAPAHOE COUNTY

COLORADO

EPA REGION VIII

WORKING PAPER No. 768

WITH THE COOPERATION OF THE

COLORADO DEPARTMENT OF HEALTH

AND THE

COLORADO NATIONAL GUARD

JUNE, 1977

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nation-wide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGEMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Colorado Department of Health for professional involvement, to the Colorado National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples.

The staff of the Water Quality Control Division provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

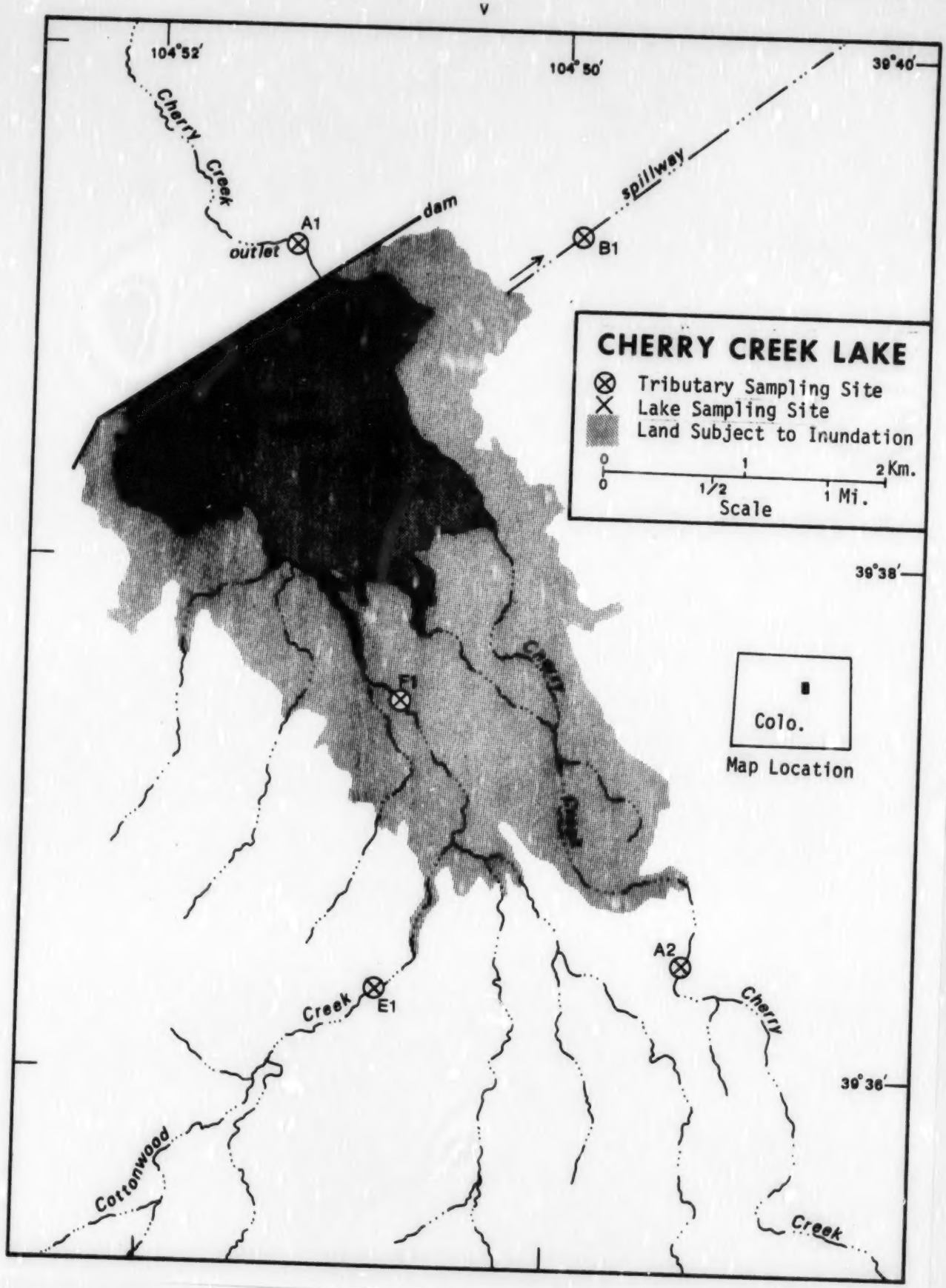
Lt. Colonel Paul A. Parsons, the Deputy Adjutant General of Colorado, and Project Officer Colonel Hershel C. Yeargan, who directed the volunteer efforts of the Colorado National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

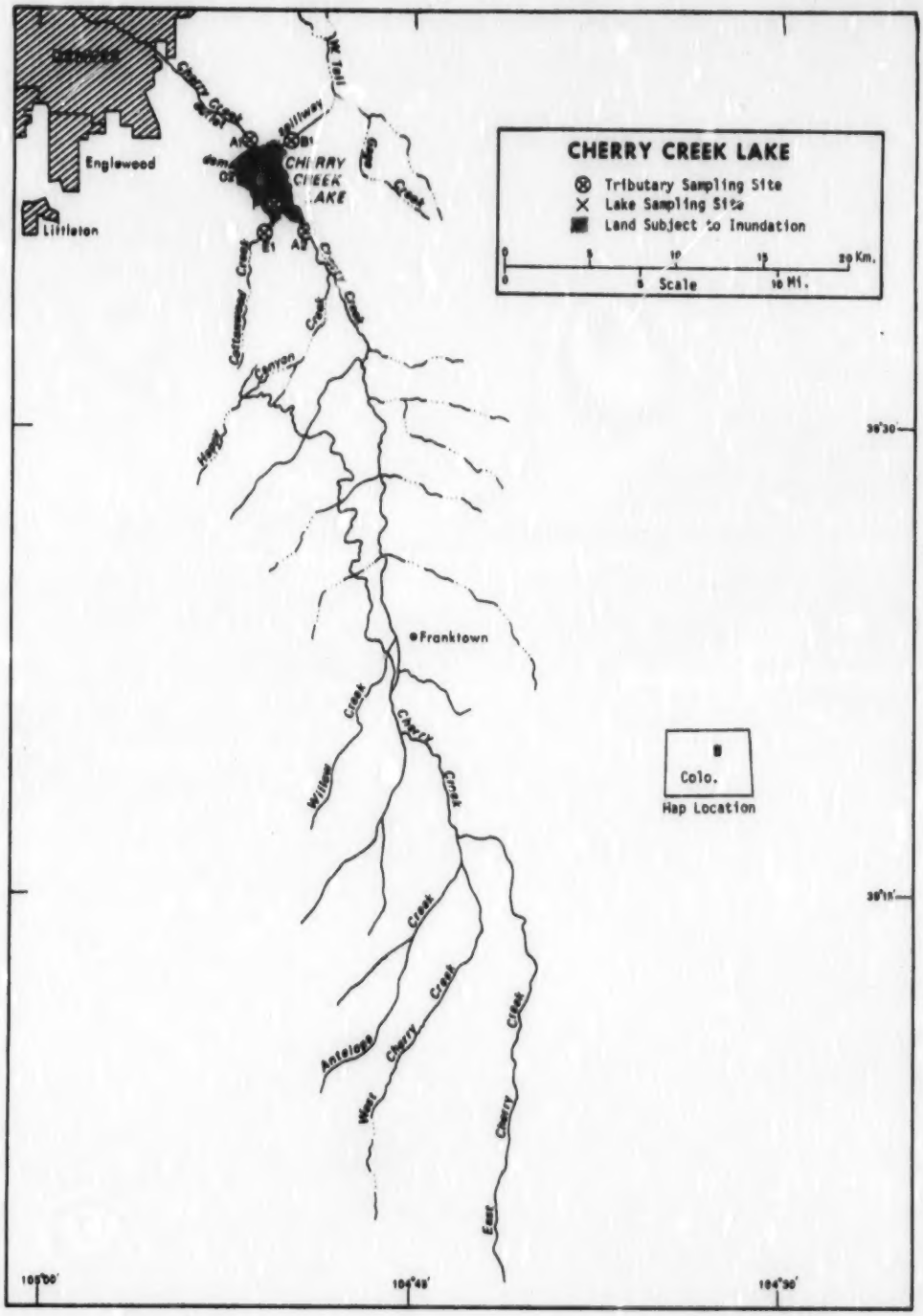
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES AND RESERVOIRS

STATE OF COLORADO

NAME	COUNTY
Barker	Boulder
Barr	Adams
Blue Mesa	Boulder
Cherry Creek	Arapohoe
Cucharas	Huerfano
Dillon	Summit
Grand	Grand
Green Mountain	Summit
Holbrook	Otero
Meredith	Crowley
Milton	Weld
Navajo	Archuleta, CO; San Juan, Rio Arriba, NM
Shadow Mountain	Grand


104°52′
104°50′
39°40′
Cherry Creek
outlet
A1
dam
spillway
B1
CHERRY CREEK LAKE
Tributary Sampling Site
Lake Sampling Site
Land Subject to Inundation
0 1 2 Km.
0 1/2 1 Mi.
Scale
39°38′
F1
Colo.
Map Location
A2
Cherry
Creek
E1
39°36′
Cottonwood
Creek


CHERRY CREEK LAKE
Tributary Sampling Site
Lake Sampling Site
Land Subject to Inundation
Scale
Km.
Mi.
Englewood
Littleton
Franktown
Colo.
Map Location
39°30'
39°15'
104°45'
104°30'

CHERRY CREEK LAKE

STORET NO. 0804

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Cherry Creek Lake is eutrophic. It ranked seventh in overall trophic quality among the 13 Colorado lakes and reservoirs sampled in 1975 when compared using a combination of six water quality parameters*. Seven of the water bodies had less median total phosphorus, six had less median dissolved orthophosphorus, none had less but six had the same median inorganic nitrogen, eight had less mean chlorophyll a, and nine had greater mean Secchi disc transparency.

Survey limnologists noted emergent aquatic macrophytes along the shoreline in August. The high chlorophyll a concentration at station 2 in August (124.6 µg/l) is indicative of an algal bloom. However, the numbers of phytoplankton in the August sample composited from the three stations indicate probable wind-concentration of the algae at station 2 (see page 6).

B. Rate-Limiting Nutrient:

The algal assay results indicate that Cherry Creek Lake was nitrogen limited at the time the sample was collected (05/07/75). The reservoir data indicate nitrogen limitation at all sampling stations and times.

C. Nutrient Controllability:

1. Point sources--No known wastewater treatment plants impacted the reservoir during the sampling year. Septic tanks serving shoreline parks and campgrounds were estimated to have contri-

* See Appendix A.

buted 0.1% of the total phosphorus load to Cherry Creek Lake during the sampling year, but a shoreline survey would have to be done to determine the actual inputs from those sources.

The present phosphorus loading of 1.53 g/m^2/year is six times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 11). It is calculated that this input would have to be reduced by 84% to significantly improve the trophic condition of the reservoir. This would involve minimization of phosphorus loads from all non-point sources.

2. Non-point sources--Non-point sources accounted for 99.9% of the total phosphorus load during the sampling year. Cherry Creek contributed 98.5%, Cottonwood Creek contributed 0.2%, and the ungaged minor tributaries and immediate drainage contributed an estimated 0.1%.

Land use in the drainage basin is largely agricultural. An additional investigation is needed to determine the contribution and controllability of nutrients resulting from land-use practices such as turf farming in the Cherry Creek drainage (Anderson, 1977).

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 3.24 kilometers ^{2}.
2. Mean depth: 5.2 meters.
3. Maximum depth: 7.6 meters.
4. Volume: 16.751 x 10^6 m^3.
5. Mean hydraulic retention time: 3.6 years (based on outflow)

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Cherry Creek	932.4	0.196
Cottonwood Creek	20.1	0.008
Minor tributaries & immediate drainage -	41.4	0.004
Totals	993.9	0.208

2. Outlet -

Cherry Creek	997.1**	0.147

C. Precipitation***:

1. Year of sampling: 42.3 centimeters.
2. Mean annual: 32.9 centimeters.

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† Table of metric conversions--Appendix B.
†† Anderson, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of reservoir.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Cherry Creek Lake was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two or more depths at three stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 5.5 meters at station 1, 3.0 meters at station 2, and 4.6 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR CHERRY CREEK LAKE
STORET CODE 0804

PARAMETER	1ST SAMPLING (5/ 7/75) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (8/22/75) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/ 9/75) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	9.7 - 10.3	10.0	10.0	22.6 - 24.3	23.2	23.2	13.1 - 13.9	13.6	13.6
DISS OXY (MG/L)	7.6 - 8.2	8.0	8.0	5.0 - 7.6	6.5	6.8	7.4 - 8.0	7.7	7.6
CNDCTVY (MCHOMO)	377. - 382.	380.	380.	564. - 770.	600.	572.	418. - 426.	422.	422.
PH (STAND UNITS)	8.5 - 8.7	8.5	8.5	8.0 - 8.5	8.4	8.4	8.1 - 8.3	8.2	8.3
TOT ALK (MG/L)	175. - 176.	176.	176.	172. - 179.	176.	177.	60. - 193.	176.	190.
TOT P (MG/L)	0.051 - 0.070	0.060	0.057	0.039 - 0.122	0.054	0.043	0.025 - 0.084	0.056	0.055
ORTHO P (MG/L)	0.009 - 0.011	0.010	0.009	0.005 - 0.025	0.010	0.007	0.002 - 0.008	0.006	0.006
NO2+NO3 (MG/L)	0.020 - 0.030	0.022	0.020	0.020 - 0.020	0.020	0.020	0.020 - 0.060	0.024	0.020
AMMONIA (MG/L)	0.030 - 0.040	0.034	0.030	0.020 - 0.030	0.021	0.020	0.020 - 0.020	0.020	0.020
KJEL N (MG/L)	0.800 - 0.900	0.840	0.800	0.700 - 1.600	0.837	0.700	0.200 - 0.800	0.656	0.700
INORG N (MG/L)	0.050 - 0.060	0.056	0.060	0.040 - 0.050	0.041	0.040	0.040 - 0.080	0.044	0.040
TOTAL N (MG/L)	0.820 - 0.930	0.862	0.820	0.720 - 1.620	0.857	0.720	0.260 - 0.820	0.680	0.720
CHLRPYL A (UG/L)	2.3 - 13.2	9.4	12.8	9.8 - 124.6	48.7	11.6	9.8 - 14.2	11.9	11.6
SECCHI (METERS)	0.8 - 0.9	0.9	0.9	0.6 - 0.9	0.7	0.7	0.6 - 0.9	0.7	0.6

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
05/07/75	1. Chroomonas (?) sp.	841
	2. Cryptomonas sp.	342
	3. Stephanodiscus sp.	156
	4. Navicula sp.	31
	5. Ankistrodesmus sp.	31
	Other genera	280
	Total	1,681
08/22/75	1. Fragilaria sp.	920
	2. Diatoma sp.	920
	3. Navicula sp.	307
	4. Stephanodiscus sp.	184
	5. Cryptomonas sp.	184
	Other genera	367
	Total	2,882
10/09/75	1. Trachelomonas sp.	373
	2. Cryptomonas sp.	248
	3. Ankistrodesmus sp.	124
	4. Stephanodiscus sp.	41
	5. Melosira sp.	41
	Other genera	84
	Total	911

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
05/07/75	1	12.8
	2	13.2
	3	2.3
08/22/75	1	9.8
	2	124.6
	3	11.6
10/09/75	1	14.2
	2	9.8
	3	11.6

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.015	0.090	3.2
0.050 P	0.065	0.090	3.9
0.050 P + 1.0 N	0.065	1.090	28.9
1.0 N	0.015	1.090	4.5

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum indicates that the potential primary productivity of Cherry Creek Lake was moderately high at the time the sample was taken (05/07/75). Also, the lack of significant growth response with the addition of phosphorus until nitrogen was also added in combination indicates that the reservoir was limited by nitrogen at that time. Note that the addition of nitrogen alone resulted in a yield significantly greater than that of the control.

The reservoir data also indicate nitrogen limitation. The mean inorganic nitrogen/orthophosphorus ratios were 9/1 or less at all sampling stations and times, and nitrogen limitation would be expected.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Colorado National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of June when two samples were collected. Sampling was begun in September, 1974, and was completed in August, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Colorado District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for unsampled tributaries were calculated using mean annual concentrations and mean annual flows. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the mean concentrations in Cottonwood Creek at station E-1 and the mean annual ZZ flow.

No known wastewater treatment plants impacted Cherry Creek Lake during the sampling year.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Cherry Creek	4,870	98.5
Cottonwood Creek	10	0.2
b. Minor tributaries & immediate drainage (non-point load) -	5	0.1
c. Known municipal STP's - None	-	-
d. Septic tanks* -	5	0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	55	1.1
Total	4,945	100.0

2. Outputs -

Reservoir outlet - Cherry Creek 745

3. Net annual P accumulation - 4200 kg.

* Estimate based on 3 campgrounds and 2 parks; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Cherry Creek	22,345	84.8
Cottonwood Creek	165	0.6
b. Minor tributaries & immediate drainage (non-point load) -	85	0.3
c. Known municipal STP's - None	-	-
d. Septic tanks* -	245	1.0
e. Known industrial - None	-	-
f. Direct precipitation** -	3,500	13.3
Total	26,340	100.0

2. Outputs -

Reservoir outlet - Cherry Creek 6,870

3. Net annual N accumulation - 19,470 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Cherry Creek	5	24
Cottonwood Creek	<1	8

* Estimate based on 3 campgrounds and 2 parks; see Working Paper No. 175.
** See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	1.53	1.30	8.1	6.0

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Cherry Creek Lake:

"Dangerous" (eutrophic loading)	0.24
"Permissible (oligotrophic loading)	0.12

V. LITERATURE REVIEWED

Anderson, R. Dennis, 1974. Personal communication (waterbody information and morphometry). CO Dept. of Health, Denver.

_____, 1977. Personal communication (review of preliminary report). CO Dept. of Health, Denver.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Water, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P
0801	BARKER RESERVOIR	0.023	0.045	419.000	5.333	9.400	0.006
0802	BARR LAKE	0.930	1.090	451.333	28.767	10.200	0.730
0803	BLUE MESA RESERVOIR	0.019	0.040	395.750	6.817	13.800	0.005
0804	CHERRY CREEK LAKE	0.054	0.040	469.333	23.322	10.000	0.007
0805	CUCHARAS RESERVOIR	0.263	0.040	490.000	27.400	14.800	0.015
0806	DILLON RESERVOIR	0.009	0.040	181.750	3.150	9.200	0.002
0807	GRAND LAKE	0.013	0.040	366.500	4.900	10.200	0.003
0808	GREEN MOUNTAIN RESERVOIR	0.010	0.040	391.167	5.833	9.100	0.002
0809	HOLBROOK LAKE	0.329	0.070	490.333	111.933	9.000	0.028
0810	LAKE MEREDITH	0.397	0.110	489.667	164.678	10.400	0.098
0811	MILTON RESERVOIR	0.846	2.280	429.333	5.900	9.200	0.808
0812	NAVAJO RESERVOIR	0.036	0.050	479.400	2.180	10.000	0.013
0813	SHADOW MOUNTAIN LAKE	0.020	0.040	427.000	5.700	9.200	0.003

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
0801	BARKER RESERVOIR	58 (7)	42 (5)	67 (8)	75 (9)	58 (7)	58 (7)	358
0802	BARR LAKE	0 (0)	8 (1)	42 (5)	17 (2)	29 (3)	8 (1)	104
0803	BLUE MESA RESERVOIR	75 (9)	87 (9)	75 (9)	42 (5)	8 (1)	67 (8)	354
0804	CHERRY CREEK LAKE	42 (5)	87 (9)	33 (4)	33 (4)	46 (5)	50 (6)	291
0805	CUCHARAS RESERVOIR	33 (4)	58 (6)	8 (1)	25 (3)	0 (0)	33 (4)	157
0806	DILLON RESERVOIR	100 (12)	58 (6)	100 (12)	92 (11)	75 (8)	96 (11)	521
0807	GRAND LAKE	83 (10)	87 (9)	92 (11)	83 (10)	29 (3)	79 (9)	453
0808	GREEN MOUNTAIN RESERVOIR	92 (11)	58 (6)	83 (10)	58 (7)	92 (11)	96 (11)	479
0809	HOLBROOK LAKE	25 (3)	25 (3)	0 (0)	8 (1)	100 (12)	25 (3)	183
0810	LAKE MEREDITH	17 (2)	17 (2)	17 (2)	0 (0)	17 (2)	17 (2)	85
0811	MILTON RESERVOIR	8 (1)	0 (0)	50 (6)	50 (6)	75 (8)	0 (0)	183
0812	NAVAJO RESERVOIR	50 (6)	33 (4)	25 (3)	100 (12)	46 (5)	42 (5)	296
0813	SHADOW MOUNTAIN LAKE	67 (8)	87 (9)	58 (7)	67 (8)	75 (8)	79 (9)	433

LAKES RANKED BY INDEX NUS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	0806	DILLON RESERVOIR	521
2	0808	GREEN MOUNTAIN RESERVOIR	479
3	0807	GRAND LAKE	453
4	0813	SHADOW MOUNTAIN LAKE	433
5	0801	BARKER RESERVOIR	358
6	0803	BLUE MESA RESERVOIR	354
7	0812	NAVAJO RESERVOIR	296
8	0804	CHERRY CREEK LAKE	291
9	0811	MILTON RESERVOIR	183
10	0809	HOLBROOK LAKE	183
11	0805	CUCHARAS RESERVOIR	157
12	0802	BARR LAKE	104
13	0810	LAKE MEREDITH	85

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR COLORADO 12/07/76

LAKE CODE 0804 CHERRY CREEK

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 997.1

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
0804A1	997.1	0.0	0.093	0.368	0.195	0.119	0.396	0.079	0.425	0.085	0.0	0.0	0.0	0.147
0804A2	932.4	0.045	0.142	0.510	0.266	0.252	0.396	0.241	0.453	0.006	0.011	0.014	0.006	0.196
0804B1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0804E1	20.1	0.001	0.001	0.002	0.001	0.0	0.028	0.020	0.037	0.0	0.0	0.0	0.0	0.008
0804F1	34.2	0.001	0.002	0.003	0.001	0.000	0.042	0.003	0.014	0.0	0.0	0.0	0.0	0.006
0804Z1	31.1	0.0	0.011	0.017	0.011	0.006	0.006	0.0	0.0	0.0	0.0	0.0	0.0	0.004

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 997.1
SUM OF SUB-DRAINAGE AREAS = 1017.8
TOTAL FLOW IN = 2.55
TOTAL FLOW OUT = 1.76

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
0804A1	9	74	0.0	28	0.0				
	10	74	0.0	19	0.0				
	11	74	0.0	10	0.0				
	12	74	0.0	19	0.0				
	1	75	0.0	12	0.0				
	2	75	0.0	9	0.0				
	3	75	0.0	8	0.0				
	4	75	0.878						
	5	75	0.031	18	0.0				
	6	75	0.0	21	0.0				
	7	75	0.0	3	0.0	27	0.0		
	8	75	0.0	23	0.0				
0804A2	9	74	0.0	28	0.0				
	10	74	0.0	19	0.0				
	11	74	0.0	10	0.0				
	12	74	0.003	20	0.0				
	1	75	0.006						
	2	75	0.031	9	0.014				
	3	75	0.113	9	0.142				
	4	75	0.085	13	0.085				
	5	75	0.042	18	0.057				
	6	75	0.057	1	0.113	21	0.028		
	7	75	0.006	3	0.0	27	0.028		
	8	75	0.006						

TRIBUTARY FLOW INFORMATION FOR COLORADO 12/07/76

LAKE CODE 0804 CHER-' C-EEK

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
0804H1	9	74	0.0	28	0.0				
	10	74	0.0	19	0.0				
	11	74	0.0	10	0.0				
	12	74	0.0	19	0.0				
	1	75	0.0	12	0.0				
	2	75	0.0	9	0.0				
	3	75	0.0	8	0.0				
	4	75	0.0	13	0.0				
	5	75	0.0	18	0.0				
	6	75	0.0	1	0.0	21	0.0		
	7	75	0.0	3	0.0	27	0.0		
	8	75	0.0	23	0.0				
0804E1	9	74	0.0	28	0.0				
	10	74	0.0	19	0.0				
	11	74	0.0	10	0.003				
	12	74	0.0	19	0.003				
	1	75	0.0						
	2	75	0.006	9	0.0				
	3	75	0.011	9	0.014				
	4	75	0.011	13	0.028				
	5	75	0.006	18	0.028				
	6	75	0.006	1	0.028	21	0.003		
	7	75	0.0	3	0.0	27	0.0		
	8	75	0.0						
0804F1	9	74	0.0	28	0.0				
	10	74	0.0	19	0.0				
	11	74	0.0	10	0.0				
	12	74	0.0	19	0.0				
	1	75	0.0						
	2	75	0.011	9	0.0				
	3	75	0.017	9	0.0				
	4	75	0.017	13	0.0				
	5	75	0.006	18	0.0				
	6	75	0.011						
	7	75	0.0	3	0.0	27	0.0		
	8	75	0.0	23	0.0				
0804Z2	9	74	0.0						
	10	74	0.0						
	11	74	0.0						
	12	74	0.0						
	1	75	0.0						
	2	75	0.011						
	3	75	0.017						
	4	75	0.011						
	5	75	0.006						
	6	75	0.006						
	7	75	0.0						
	8	75	0.0						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/09/24

080401
39 38 58.0 104 51 15.0 3
CHERRY CREEK LAKE
08005 COLORADO

091091

11EPALES 2111202
0010 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/07	10 45	0000	9.7	8.2	33	377	8.50	175	0.030	0.900	0.030	0.009
	10 45	0006	9.7	8.0		378	8.50					
75/08/22	14 25	0000	22.9	7.2	36	574	8.00	175	0.020K	0.800	0.020K	0.005
	14 25	0005	23.1	6.4		770	8.30	177	0.020K	0.700	0.020K	0.007
	14 25	0018	22.6	6.0		567	8.35	179	0.020K	0.700	0.020K	0.007
75/10/09	10 55	0000	13.9	8.0	24	422	8.15	192	0.020K	0.600	0.020K	0.005
	10 55	0005	13.5	8.0		422	8.20	192	0.020K	0.800	0.020K	0.008
	10 55	0015	13.1	7.6		418	8.25	190	0.020K	0.800	0.020K	0.005

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/07	10 45	0000	0.057	12.8	
75/08/22	14 25	0000	0.039	9.8	
	14 25	0005	0.041		
	14 25	0018	0.043		
75/10/09	10 55	0000	0.059	14.2	
	10 55	0005	0.084		
	10 55	0015	0.071		

K VALUE KNOWN TO BE
LESS THAN INDICATED

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STORET RETRIEVAL DATE 76/09/24

080402
39 38 18.0 104 51 57.0 3
CHERRY CREEK LAKE
08005 COLORADO

091091

11EPALES 2111202
0013 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/07	11 05	0000	10.2	8.2	37	380						
	11 05	0009	9.9	7.6		378	8.50	175	0.040	0.800	0.020K	0.009
75/08/22	14 00	0000	24.3	7.6	26	607	8.50	172	0.020K	0.700	0.020	0.025
	14 00	0005	23.4	5.0		564	8.50	172	0.020	1.600	0.020K	0.014
75/10/09	11 15	0000	13.9	8.0	24	425	8.20	187	0.020K	0.800	0.020K	0.006
	11 15	0005	13.9	7.6		425	8.25	188	0.020K	0.600	0.020K	0.006
	11 15	0010	13.5	7.4		422	8.25	187	0.020K	0.700	0.020K	0.007

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/07	11 05	0000		13.2	
	11 05	0009	0.056		
75/08/22	14 00	0000	0.055	124.6	
	14 00	0005	0.122		
75/10/09	11 15	0000	0.053	9.8	
	11 15	0005	0.056		
	11 15	0010	0.055		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

080403
39 38 12.0 104 50 55.0 3
CHERRY CREEK LAKE
08005 COLORADO

091091

11EPALES 2111202
0019 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/07	11	30 0000	10.3	8.0	36	382	8.70	176	0.030	0.800	0.020K	0.009
	11	30 0005	10.2	8.0		381	8.50	176	0.040	0.800	0.020K	0.010
	11	30 0015	10.0	8.0		382	8.50	176	0.030	0.900	0.020K	0.011
75/08/22	14	30 0000	23.4	7.2	24	579	8.50	177	0.020K	0.800	0.020K	0.006
	14	30 0005	23.5	7.2		570	8.50	177	0.030	0.700	0.020K	0.007
	14	30 0014	22.6	5.8		565	8.40	177	0.020K	0.700	0.020K	0.006
75/10/09	10	40 0000	13.7	7.6	36	426	8.10	60	0.020K	0.200K	0.060	0.002K
	10	40 0005	13.6	7.4		421	8.25	193	0.020K	0.700	0.020K	0.006
	10	40 0010	13.4	7.6		418	8.30	193	0.020K	0.700	0.020K	0.005

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/07	11	30 0000	0.051	2.3	
	11	30 0005	0.070		
	11	30 0015	0.065		
75/08/22	14	30 0000	0.044	11.6	
	14	30 0005	0.048		
	14	30 0014	0.043		
75/10/09	10	40 0000	0.025	11.6	
	10	40 0005	0.050		
	10	40 0010	0.047		

K VALUE KNOWN TO BE
LESS THAN INDICATED

25

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/09/24

0804A1
39 34 11.0 104 51 20.0 4
CHERRY CREEK
08 7.5 FITZSIMONS
O/CHERRY CREEK LAKE 091091
I225 BRDG .9 MI SW OF PARKER RD UNDERPAS
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/05/18	08 30		0.020	1.200	0.020	0.015	0.110
75/06/01	10 05		0.575	1.350	0.040	0.035	0.110
75/06/21	11 45		0.145	1.000	0.075	0.110	0.180
75/07/03	16 25		0.180	1.050	0.080	0.085	0.140
75/07/27	09 15		0.550	0.450	0.195	0.230	0.325
75/08/23	08 45		0.270	2.100	0.040	0.025	0.100

27

STORET RETRIEVAL DATE 76/09/24

0804A2
39 36 27.0 104 49 20.0 4
CHERRY CREEK
08 7.5 PARKER
T/CHERRY CREEK LAKE 091091
BNK 100 FT E OF SEC RD 1.6 M N RT 88 JCT
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/02/09	09 00		2.100	1.900	0.032	0.240	0.250
75/03/09	08 30		1.500	3.600	0.040	0.264	1.700
75/04/13	09 00		1.880	2.800	0.035	0.240	0.520
75/05/18	09 45		0.090	0.700	0.020	0.085	0.150
75/06/01	10 38		1.150	4.500	0.025	0.260	1.900
75/06/21	12 20		0.870	0.600	0.015	0.180	0.210

88

STORET RETRIEVAL DATE 76/09/24

080481
39 39 15.0 104 49 55.0 4
SPLWY TO W TOLL GAGE CR
08 7.5 FITZSIMONS
O/CHERRY CREEK LAKE 091091
SPILLWAY AT ST RT 83 BRDG
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/09/28	14 00		0.012	1.100	0.020	0.010	0.020
74/11/10	13 30		0.232	0.700	0.030	0.005K	0.010K
74/12/19	14 40		1.960	1.300	0.200	0.008K	0.010
75/01/12	09 30		0.740	1.500	0.464	0.008K	0.070
75/02/09	08 30		0.880	1.300	0.464	0.008K	0.010
75/03/08	15 00		2.200	1.700	0.136	0.008K	0.030
75/04/13	08 30		0.620	2.900	0.070	0.010	0.010
75/05/18	09 00		0.055	1.000	0.115	0.010	0.030
75/06/01	11 00		0.055	1.200	0.075	0.005	0.030
75/06/21	12 40		0.015	1.100	0.060	0.015	0.050
75/07/03	17 20		0.015	1.950	0.100	0.045	0.090
75/08/23	09 30		0.005	0.165	0.030	0.025	0.170

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

0804E1
39 36 20.0 104 50 50.0 4
COTTONWOOD CREEK
08 7.5 PARKER
T/CHERRY CREEK LAKE 091091
PEORIA ST BRDG .7 MI N OF RT 88 JCT
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	15 00		0.024	1.000	0.025	0.020	0.030
74/12/19	15 40		0.064	0.600	0.032	0.048	0.070
75/03/09	09 00		0.015	0.500	0.032	0.008K	0.040
75/04/13	10 00		0.005	0.450	0.025	0.010	0.010
75/05/18	10 00		0.015	0.450	0.025	0.015	0.060
75/06/01	10 21		0.015	0.950	0.035	0.015	0.040
75/06/21	12 05		0.005	0.500	0.027	0.015	0.060

K VALUE KNOWN TO BE
LESS THAN INDICATED